Introduction

Extremity War Injuries: Current Management and Research Priorities

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The United States Armed Forces have been engaged in combat operations for more than 10 years. Not enough can be said about nor enough gratitude expressed to our troops for their commitment and sacrifice during this period. This supplement to the *Journal of the American Academy of Orthopaedic Surgeons* is dedicated to the men and women of the United States Armed Services and to their families and friends who support them.

The terrorist attacks on New York City, Washington, DC, and Pennsylvania on September 11, 2001, set in motion what has become the longest sustained armed conflict in American history. In the past decade of war, much has been learned about the care of the combat casualty and combat-related wounds. These advances would not have been possible without the cooperation of many dedicated civilian orthopaedic organizations.

Since combat operations began in 2001, more than 6,400 US service members have lost their lives, and more than 48,000 have sustained combat injuries.[1] Troop vehicle design, body armor, and far-forward advanced surgical care have combined to yield the highest war injury survival rates in history. In World War II, the survivability rate was 70.7%.[2] This rate increased to the mid 70th percentile for the conflicts in Korea and Vietnam. For the conflicts in Iraq and Afghanistan, the survivability rate was 89.7% as of 2011. Survivability steadily increased from 80.8% in 2001 to 92.0% in 2011.

More than 70% of combat casualties suffer extremity trauma.[3] Unpublished data obtained from the US Military Amputee Database indicate that as of April 24, 2012, 1,453 injured US service members had required limb amputation, with 1,015 experiencing single limb loss and 438 experiencing multiple limb loss. Many other wounded service members have undergone successful limb salvage.

The inaugural Extremity War Injuries (EWI) symposium, held in 2006, focused on the difficulties related to combat casualty care and defined the state of practice at that time. At that meeting, knowledge gaps were identified and research priorities established. As a result of the annual EWI symposia series, several different funding mechanisms became available to investigate the problems facing surgeons and patients. This cycle was refined over subsequent symposia, focusing on particularly difficult problems, potential solutions, and reports of advances made. Subsequent symposia have focused on the challenges of orthopaedic care and reconstruction, such as infection, bone loss, and posttraumatic arthritis. New challenges have arisen, such as limiting combat-related death resulting from severe extremity heterotopic ossification and treating patients with multiple limb loss.

EWI VI, "Data-Driven Progress in

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Combat Casualty Care," held January 19–21, 2011, in Washington, DC, focused on injury prevention and mitigation, long-term disability in combat casualties, and the continued challenges of maximizing functional recovery following limb salvage and amputation. The 13 articles generated from this symposium address these topics as well as multimodal strategies for pain control and the lack of uniformity in assessment tools used to determine functional ability and self-reported outcomes.

EWI VII, "A Decade at War: Evolution of Orthopaedic Combat Casualty Care," held January 18–20, 2012, in Washington, DC, examined the three phases of patient care: acute care, reconstruction, and rehabilitation. The last seven articles of this supplement address lessons learned, outcomes measures, current strategies, and knowledge gaps for each phase. Participants discussed ways to improve resident education in the treatment of wounded warriors and predeployment training of military medical personnel.

Proper tourniquet use, effective medical evacuation from theater, damage control resuscitation, skillful surgical débridement, and infection control are key elements of acute care. The tourniquet is one of the most promising lifesaving military achievements of the recent conflicts, and the lessons learned in the dramatic decrease in mortality rates of injured service members after far-forward implementation of tourniquets may translate to the civilian sector. Significant treatment challenges are associated with multiple amputations and limb salvage in patients with multisystem injuries caused by the newly described dismounted complex blast injury. Even though patient rehabilitation has improved with the advent of pain management protocols and techniques that have enabled earlier initiation of therapy, rehabilitation remains less effective for limb salvage patients than for amputees.

The Major Extremity Trauma Research Consortium is currently analyzing and comparing data from the Lower Extremity Assessment Project and the Military Extremity Trauma Amputation/Limb Salvage studies, with the intent of advancing evidence-based patient-centered care. The global effects of severe trauma point to the need for a multidisciplinary approach to trauma care. Axioms in combat casualty care have been altered by 7 years of combat-related research. Recent research has shed new light on aspects of medical evacuation, wounding patterns, and bioburden, which has resulted in improved patient care.

At the EWI VII Symposium, several research priorities were outlined in the areas of acute care, reconstruction, and rehabilitation, including the development of mechanisms to obtain junctional large-vessel control in the groin and axilla, education in and the effectiveness of surgical débridement techniques, use of the Masquelet technique for bioactive membrane formation and other segmental defect techniques, timing of wound closure and flap coverage, long-term complications of disability secondary to posttraumatic arthritis, and long-term complications following amputation and limb salvage.

Military surgeons recognize the underpublicized burden of disability experienced by limb salvage patients. Arthritis and functional loss related to nerve injury or missing muscle are common sequelae of lower extremity limb salvage. The EWI VIII symposium, scheduled for February 9–11, 2013, in Washington, DC, will focus on the sequelae of combat injuries, including joint preservation and joint replacement in patients with posttraumatic arthritis, complex upper extremity injuries, infection, junctional injuries, multiligamentous knee injuries, and long-term sequelae of amputation.

The annual EWI symposia provide a collaborative forum in which military and civilian surgeons establish and execute an aggressive research agenda focused on topical clinical issues. The US Department of Defense and congressional leaders recognize the potential positive impact on both military and civilian trauma patients and continue to support and participate in the symposia. Importantly, Congress has continued to allocate significant funds to support basic sci-

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For additional information on the EWI symposia series, please visit www.aaos.org/ewi.

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